FLOSSCom - Using the Principles of Informal Learning Environments of FLOSS Communities to Improve ICT Supported Formal Education

FLOSS-like education transfer report

Work Package Number: **05**

Work Package Title: **Phase 3 FLOSS-like education transfer report**

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Date (version): 25-09-2008

Availability: General Public

Document Id: FLOSSCOM_WP4_PHASE2_REPORT_d1

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Preposition

Free/Libre and Open Source Software (FLOSS) communities are not only an exemplar for successful software development, but also for well working learning environments. Yet little is known about how learning occurs in the FLOSS communities and what the underlying success factors are. FLOSS communities might be seen as an example of 'Best Practice' in how ICT can help to improve education in terms of learning processes, up to date content and open inclusive education where no learner is excluded from participation.

The FLOSSCOM project was undertaken in order to evaluate how learning in FLOSS is organised and if, to which degree, and how FLOSS learning principles can be transferred to and used for the improvement of ICT supported formal education. Precisely, the FLOSSPOLS project intended to

- identify the factors that contribute to successful knowledge construction in informal learning communities, such as the FLOSS communities
- analyze the effectiveness of a FLOSS-like learning community in a formal educational setting
- provide case studies, scenarios and guidelines for teachers and decision-makers on how to successfully embed such learning communities within formal educational environments to enhance student progression, retention and achievement
- evaluate the project and disseminate the results to the wider community.

This report is the third and final report of the FLOSSCOM project. It provides scenarios and guidelines for teachers and decision-makers as practical documentation on how principles of FLOSS-like informal learning communities can be transferred to formal educational environments in order to enhance student progression, retention and achievement.

1 Introduction: FLOSS-like learning and higher education

Formal education tends to assume learning is an individual process with a beginning, middle and an end, and usually separated from other activities. This is reflected in the teaching practices within many 'formal' institutions. One's ability is assessed through the use of tests, where students "struggle in one-on-one combat", where knowledge is exemplified with no context, and where collaboration and team-work is considered to be cheating (Wenger, 1998).

Free / Libre and Open Source Software (FLOSS)-like communities offer an alternative framework for learning to the overcome traditional formal learning environments. The FLOSS learning approach places learning in the context of one's experience and the world. This approach is very much focused on the learners and their preferences, and on the theory of social learning, collaboration, communication and sharing.

In terms of the community concept, FLOSS communities[1] might be seen as special kinds of online communities of practice where the focus is on software development, maintenance, and support. The Internet continues to support the emergence of such virtual communities across a diverse range of topics and interests. Figure 1-1 exemplifies the elements that form a FLOSS community and outlines all the contributors to the community and its outcomes.

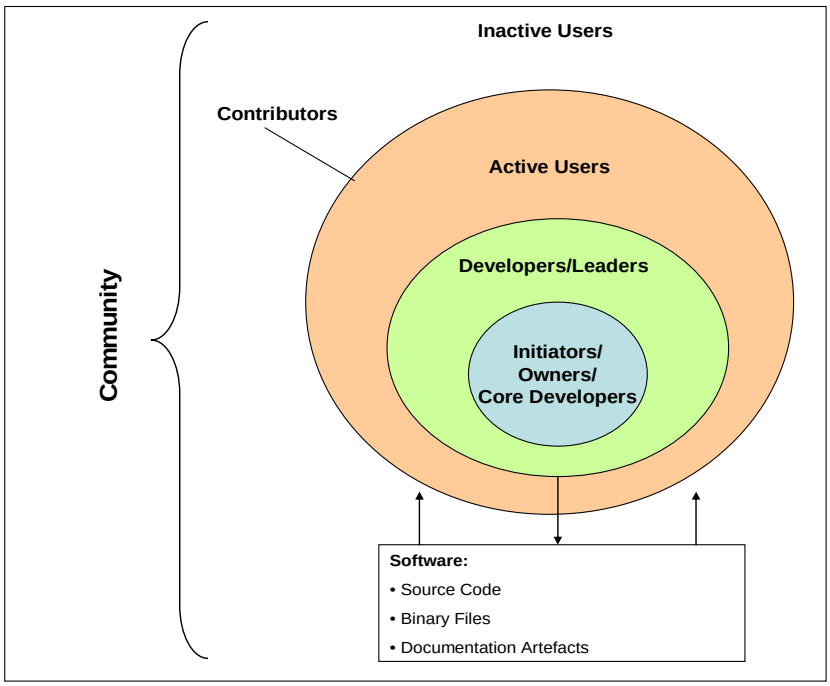

Figure 1-1: FLOSS Community Diagram (Stürmer, 2005)

[1] Defining FLOSS is a difficult task as the literature uses an array of terminology interchangeably. However, the definition being used throughout this report refers to the end product that is produced as a result of the communities' existence. This product may be a piece of software or could be a report or a paper. Additionally, learning within FLOSS communities, as shown at the FLOSSCom Phase 1 and Phase 2 reports, is not only referring to the development of the software itself, but the FLOSS ecosystem at large; involving a significantly higher number of participants, activities and artifacts.

It is clear from the diagram that at the heart of the community is the Initiator, Owner or Core Development Group. Thus, it is generally these people around which a community emerges. FLOSS-like communities are thought to be organic, i.e. self organised. The formation of a community does require someone to start it off. Raymond (1999) suggests that this is the "scratching (of) a developer's personal itch" (Raymond, 1999). This suggests that a community is initiated because an individual i.e. a developer has reached a certain stage of his/her personal development project and wishes to recruit the help of others to progress.

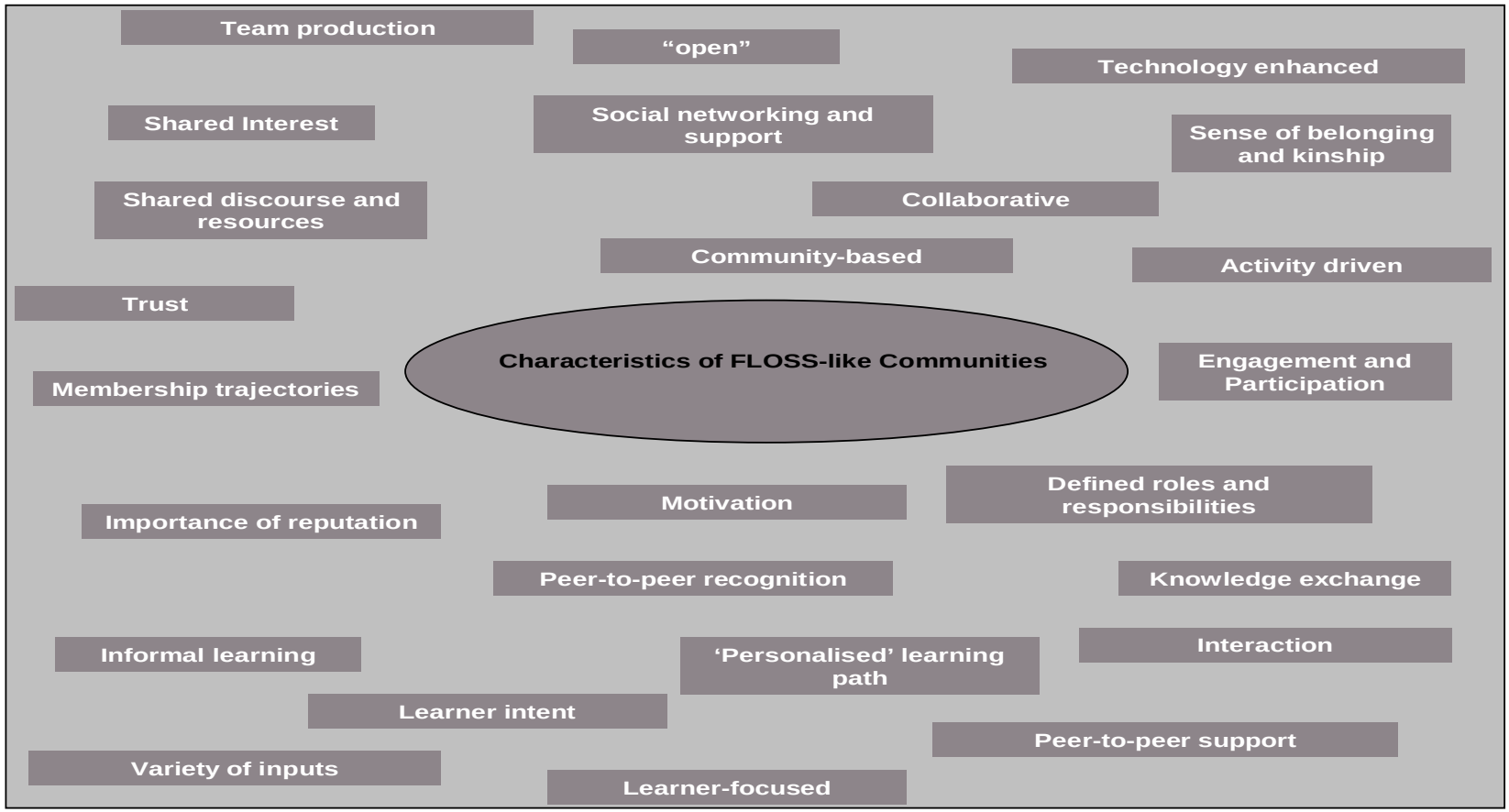

Figure 1-2: Characteristics associated with FLOSS-like Communities

Figure 1-2 illustrates the multitude of characteristics that are associated with the interaction of members of FLOSS-like communities. From the community point of view, however, not all of these characteristics are necessarily essential when breaking down what a FLOSS-like community really is. Conversely, the characteristics as shown at table 1-1 are critical in order for a community to be classified as a FLOSS-like community:

Characteristic	Reasoning
Product/Problem based rather than process based (context dependent)	As detailed at the outset the community exists in order to create a product. This end-product may refer to a report, paper, a piece of software or a solution.
Led by a champion	A champion is essential as it is usually the 'champion' that kicks-off the community. Therefore, they are usually critical in supporting and contributing to the development of the product.
Participant (learner) oriented	Essential as the participants/learners make up the community and they effectively control the activity and without them the community would be non-existent.

Table 1-1 FLOSS-like community core characteristics

The analysis of the organisation of learning in FLOSS communities that has been carried out in earlier phases of the FLOSSCOM project has confirmed that FLOSS communities are indeed worthwhile to be considered as a prime exemplar of informal learning environments; and as a benchmark for other attempts to organise learning in a more self-organised and opener way than traditional learning environments. What makes FLOSS communities effective learning environments has been described by Meiszner, Glott & Sowe (2008c) as follows:

> "The FLOSS case is likely the most mature and developed learning ecosystems to be found at the web. FLOSS communities succeed in providing and distributing in a sustainable manner the knowledge necessary for the production of good quality software. They apply a different development approach than proprietary software producers, as software is built by a community of volunteers and companies, the latter generating revenues from the provision of services rather than from selling software. Knowledge is created collaboratively by experts and users, support is provided by user to user support systems, and sustainability and quality are also assured through community involvement.
>
> Therefore, FLOSS communities gained attention for their community production and support models and their way of knowledge creation, sharing, and learning opportunities. FLOSS turned out to be an ecosystem that goes way beyond the pure production of software. From the learner's point of view, participating in this ecosystem is not per se and not only dependent on good programming skills. Besides coding skills, FLOSS also requires and provides expertise in patents law, license issues, management skills, capacities to mobilise community members, or language skills." (Meiszner, A, Glott, R. & Sowe, S. K. 2008c)

As earlier reports from the FLOSSCOM project have shown,[2] many of the findings on learning in FLOSS are in contrast to the way in which learning occurs in today's settings of higher education. Within this report we will consider how these approaches to learning in FLOSS communities might be implemented in higher education (HE) in order to improve it. We therefore provide examples, scenarios and guidelines for teachers and decision-makers on how learning communities similar to FLOSS communities can be embedded within more formal educational environments to enhance student progression, retention and achievement.

Transferring FLOSS-like learning principles to HE does not mean that traditional higher education practices get fully abandoned. There are a number of higher education practices that are valuable in ensuring all students have a good chance of success. For example, while the FLOSS approach is community-oriented and thus very learner-centred, it has been found that more traditional teacher-centred approaches are often better for less adept students (Giles et al 2006). These advantages must be kept whatever change or transformation of HE is aimed for.

It is therefore important not to aim at a full replacement of the principles of one system (traditional HE) through another (FLOSS-like learning). What is required is the optimal mix of the best principles of both systems in order to achieve maximal synergies. Therefore, FLOSS-like learning principles become useful to be transferred to traditional HE only where they help to significantly improve the learning situation and outcome of at least a group of learners.

For instance, regarding the above-mentioned example of advantages of traditional HE when the learning outcome of less adept students is considered, it might not be useful to replace the teacher-centric approach by a learner-centric one. But implementing a FLOSS-like broader range of learning materials and peers support within a traditional teacher-centred approach would benefit all students, including the less adept ones.

However, true FLOSS-like approaches have rarely been implemented, and although the teacher centered approaches may be useful for students, that may be because they are the approaches that are suited to the system, particularly the assessment methods that are established. Put simply, they are a good means of getting students to pass exams because that is what the educational system has been created to do. It does not necessarily mean they are the best methods for getting people to *learn*, and to retain that knowledge over time. It could be argued that within a FLOSS-like approach the less adept students benefit through the content richness, the fact that they can easily follow the process that others used to solve a problem / fulfill a task, and through asking unanswered questions. If one looks at the largest FLOSS user group, i.e. lurkers, these can be compared to less adept students that consume resources, but do not reciprocate. In FLOSS however, resources are not consumed (browsing a forum does not consume, demanding teacher's time does), or if consumed (by asking for individual help) the output (answer) is again 'in the commons' and here the cycle starts again.

The following sections will provide an overview of FLOSS-like characteristics and approaches that are considered to be desirable for HE, scenarios and guidelines for teachers and decision-makers on how learning communities similar to Free / Libre Open Source Software (FLOSS) communities can be embedded within more formal educational environments. This report is further supported by a number of FLOSS-

[2] See the FLOSSCOM Phase 1 report and the FLOSSCOM Phase 2 report at www.flosscom.net

like case studies that where compiled over the past month. The detailed case studies are available for download at the FLOSSCom.Net repository.

2 FLOSS-like characteristics from an educational perspective

The FLOSSCom Phase 2 report revealed a number of different FLOSS characteristics that would be desirable for Higher Education, notably:

- Openness – most educational courses are 'closed'. In monetary terms this means that students have to attend, pay or sign up for a course. One way of adopting a FLOSS-like approach is to make the content of a course open, and free to access. The wider concept of openness however also includes transparent structures and user engagement as detailed at the points below
- User generated content – another means of embracing FLOSS principles is to allow students to contribute to the creation of the content itself, as in software projects.
- Peer production – active engagement in producing something with a set of peers is a powerful motivational and educational driving force.
- Real activities – engaging in legitimate activities that are not restricted to an artificial university setting also provides valuable experience.
- Contribution to the process – one important aspect of FLOSS communities are the different roles that individuals undertake, such as maintaining forums, testing software, peer review the work of others or to provide support to their peers.
- Greater sharing of knowledge – in higher education much of the previous input is lost, whereas in FLOSS the dialogue, resources, and outputs remain as learning resources.
- Peer support – a large support network provided (voluntarily) by peers in a collaborative manner nearly 24/7.
- A more personalized learning experience – instead of learning objectives that apply to a whole cohort, a FLOSS approach allows learners to gather the elements of knowledge they require.
- Informal learning – learning in FLOSS communities is through access to peers and a community, rather than formal structured support systems. In this respect most of the case studies that were carried out in the FLOSSCOM project[3] are not similar because they tend to relate to formal courses. A greater range of inputs – not just from the educator, but from all contributors so the collective is the source of knowledge, not one individual
- Use of technologies – using the type of technologies that are adopted in FLOSS communities and in the same way, e.g. using forums as a means of discussion but also as a learning resource.

[3] See http://flosscom.net/index.php?option=com_docman&task=cat_view&gid=30&Itemid=116

- Open learning ecosystem – The sum is bigger than its parts, thus there is the need of providing new educational models and scenarios that are not limited to students formally enrolled at a course.

Which of those characteristics should be implemented depends on the context and the objectives of a transfer project. Both, context and objectives, determine the scope of the transferred principles and the transfer approach. In the FLOSSCOM Phase 2 Report, three different approaches for the transfer of FLOSS-like learning principles were made: inside, outside, or hybrid. These will be discussed further in the next section.

3 Possible adoption of FLOSS-like approaches: Inside, Outside & Hybrid

There are three possibilities of adopting FLOSS-like characteristics: One way of thinking about the adoption of FLOSS principles is to consider them as FLOSS-inside, i.e. bringing FLOSS principles into a traditional HE establishment, or FLOSS-outside, i.e. exposing students to a real FLOSS-like community, or ultimately by blending them into a hybrid approach as outlined in Figure 3-1.

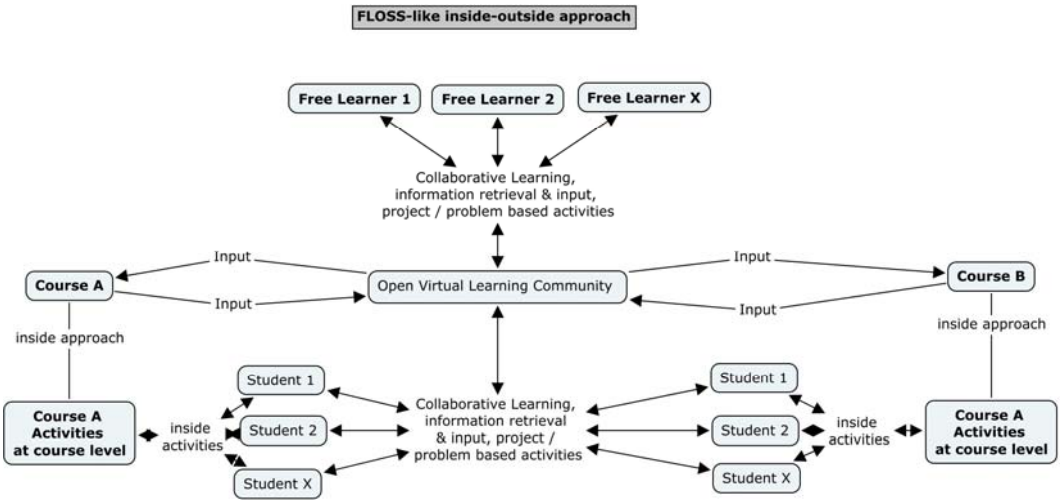

Figure 3-1: Mixed inside-outside approach of FLOSS-like education

With FLOSS-inside approaches, educators can take some of the existing practices found in FLOSS communities and employ them within a conventional higher education setting. FLOSS is incorporated in a HE setting. However, some of the constraints of higher education mean that this transfer may not always be complete because key features of traditional HE, such as a fundamental distinction between learners and teachers, performers and evaluators, must be kept. A FLOSS-inside approach is therefore always a compromise between the old and the new that requires careful planning from those who design and manage the transfer processes.

With FLOSS-outside approaches, educators can define learning units (e.g. courses, student research projects, seminar papers, and the like) that the students must pass in a FLOSS-like community (or, e.g. in computer science, in the FLOSS community itself). HE content is incorporated in a FLOSS(-like) setting. This provides students

with an experience of a real FLOSS like community, providing them with richer and more up to date learning materials and allowing them to gain soft and key skills on the fly through real interactions in the virtual world. This obviously has benefits in the field of software development, but also in other subject areas as it gives students experience of real collaboration and accepting feedback. However, the opportunities for this type of approach may be limited, since it relies on an existing FLOSS-like community to be realised, and these may not be present in every subject area.

The hybrid approach, i.e. simultaneously incorporating FLOSS-like elements in the HE environment and HE elements in FLOSS-like settings, may seem the best option because it allows a continuous evaluation (by educators as well as by students) of what "the best of both worlds" is and how the transferred elements actually suit in their respective new environments. The other side of the coin is that the hybrid approach probably requires the most drastic overhaul of higher educational practices to achieve. However, given the interest in social networks, web 2.0, user generated content, open educational resources, etc. it may be that such an approach has momentum behind it from several different drivers and thus we may see versions of this becoming accepted practice over the coming years.

All of the three approaches involve educators and formally enrolled students. If the inside approach has been chosen, they might be limited to one HE institution. If the outside approach or the hybrid approach are chosen, educators and enrolled students might involve several HE institutions in a more (hybrid approach) or less (outside approach) unstructured and disconnected way.

There are at least two further groups that can be found within the inside, outside or hybrid approaches: "free learners" and "normal participants".

"Free learners" are learners outside of formal education that participate with the intentional objective to learn. This group is (1) a consumer at the inside approach, (2) might be active at the outside approach but not connected in a structured way to formally enrolled students and (3) active at the hybrid approach and connected to formally enrolled students in a structured way.

"Normal participants", on the other hand, can be found at the outside and hybrid approach and are the regular participants of a given community (e.g. Jishka, Yahoo answers, or PhysicsForum) [4].

In reality, there are various examples that show how elements of FLOSS approaches could be applied within educational settings. As by now existing cases, as e.g. presented at the FLOSSCom Phase 2 report[5], fall broadly within either the FLOSS-inside or the FLOSS-outside category.

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[4] Jishka is a forum that assists thousands of children and teenagers with schoolwork everyday by publishing educational content and providing instant-help services for students who need urgent help (http://www.jiskha.com) / Yahoo answers allows finding and sharing information where individuals can ask questions on any topic and get *answers* from real people (http://answers.yahoo.com). / PhysicsForums is an informal collaboration space where people can chat about maths, physics and science. The forum went online in 2003 and had 77.203 members that started 154.509 threads and received 1.341.084 answers by November 2007. http://www.physicsforums.com. Those are only three randomly picked up examples out of myriads to be found at the web.

[5] The full case studies are available for download at the FLOSSCom repository

Table 3-1 aims to detail the impact of applying FLOSS-like inside, outside and hybrid approaches within an educational setting. Therefore table 3-1 provides a simplified overview on the implementation of FLOSS like approaches on the level of a course module.

As a conclusion, there is a gradual increase of opportunities for both, learners and educators, from the insider over the outside to the hybrid approach across all relevant criteria that can be applied in order to measure the scope to which learning resources are provided.

FLOSS-like educational approaches			
	Inside	Outside	Hybrid
Open Learning Environment / Ecosystem			
HE institutional virtual spaces	X		X
Outside virtual community space(s)		X	X
Interactions			
F2F on campus	X - of 1 institution	X - of 1 institution	X - of various participating institutions
Virtual	X	X	X
Learning User Groups			X - self organized learning groups, analogue to e.g. Linux User Groups that meet F2F
Level of Openness			
Static Content	Educator/Student can edit / Free learner can view	Educator/Student & normal participant can view & edit	Educator/Student, Free learner & normal participant can view & edit
Dynamic Content (e.g. Discourse)	Educator/Student can edit / Free learner might view	Educator/Student & normal participant can view & edit	Educator/Student, Free learner & normal participant can view & edit
Participation	Educator/Student can edit / Free learner not	Educator/Student & normal participant can participate	Educator/Student, Free learner & normal participant can participate
Characteristics			
User generated content	Educator/Student - rather small scale	Educator/Student & normal participant - potentially large scale	Educator/Student, Free learner & normal participant - potentially very large scale
Peer production	Educator/Student - rather small peer group	Educator/Student & normal participant - potentially larger peer groups and / or higher number of groups	Educator/Student, Free learner & normal participant - potentially high number of peer groups and break down in sub-groups working on particular subjects / projects. Sub-groups might consist of formally enrolled students only, or mixed groups
Contribution to the process	Educator/Student - rather limited but very structured	Educator/Student & normal participants - though the later might assume a dominating role as the student has a fixed entrance and exit date and therefore might be seen rather as a "Newbie"	Educator/Student, free learner & normal participants - though again once "invading" the outside space of established communities (e.g. Wikipedia) normal participants might assume a dominating role
Greater sharing of knowledge	Educator/Student - rather limited	Educator/Student & normal participant - potentially large scale	Educator/Student, Free learner & normal participant - potentially very large scale
Connection of content & discourse	Only if earlier and future students are involved in current students' activities -	Yes, though based at the web and therefore might be disconnected for future students, or	Yes, since this scenario involves formally enrolled students from various institutions it allows to shape

	e.g. Earlier students as mentors, future students as lurker	at least requires them to figure out the connection themselves. Again earlier and future students might be involved in current students' activities to allow a connection - e.g. Earlier students as mentors, future students as lurker. Students are only "guests" at the outside space and therefore the space is not shaped for their needs	inside space in order to suits students' needs. Students from different institutions will also have different start and end times that might help to assure an equilibrated ratio of students, free learner and normal participants and lead to continuity and evolution.
Peer support	Educator/Student - rather limited	Predominantly by normal participants	Educator/Student, Free learner & normal participant - potential for robust support structure
Peer assessment	Educator/Student - rather limited	There might be a peer assessment, either unorganized by normal participants or organized by other students	Two types of peer assessment: unorganized by normal participants and organized by other students & free learners
Real activities	Educator/Student - rather limited	Educator/Student & normal participant - potential for engagement in real activities	Educator/Student, Free learner & normal participant - potential for engagement in real activities
Personalized learning experience	Educator/Student - rather limited / Free learner can "consume" what they are personally interested at	Educator/Student & normal participant - potential for personalizing the learning experience	Educator/Student, Free learner & normal participant - potential for truly personalized learning experiences
Informal learning	Educator/Student - rather limited / Free learner can "consume" what they are personally interested at	Formal and informal learning - formal learning clearly structured	Formal and informal learning - formal learning more unstructured
Use of technologies	Limited to available institutional tools	Limited to available tools used by outside community	Large and diverse range of involved tools and spaces, based "out" at the web as well as across participating institutions. Likelihood of having "champ hosts" for different modules that could be institutional or existing web communities.
Speed of innovation and evolution	Slow	Depending on outside community, potentially faster than inside approach	Fast, perpetual beta
Speed of learning	Fast	Depending on outside community, potentially slower than inside approach	Depending on the learner and type of support provided for formally enrolled students. Likely slower for newbies, but faster for ICT literate learner
Scope of learning	Limited, predictible	Enhanced, fairly predictible	Widest, with guaranteed minimum scope for formally enrolled students depending on institutional guidance
Unique **S**elling **P**oints	· Transparency of environments improves quality	· Real life learning with resulting higher degree of soft skills, key and practical skills	· Transparency of environments improves quality
	· Meets social responsibility	· Enhanced employability chances as a result of the points above	· Meets social responsibility

	· Possibility to attract higher number of future students (that might also match better - "know before what they buy")	· Opportunity to meet future employer	· Possibility to attracts higher number of future students (that might also match better - "know before what they buy").
			· Real life learning with resulting higher degree of soft skills, key and practical skills
			· Enhanced employability chances
			· Opportunity to meet future employer
			· Allows for new HE business models - e.g. learning for free as you go, pay for services (f2f classes, formal assessment, degrees)
			· Allows for niche courses and identification of rising stars at low costs.
Examples			
	Utopia Discovery	Aristotle University	None, by now
	St. Cloud State University	Washington Bothell	

Table 3-1 FLOSS-like educational approaches

4 FLOSS-like educational scenarios by module, course and across schools

Implementing FLOSS-like approaches into formal educational structures might come with a high complexity. This section will provide some scenarios on applying FLOSS-like approaches. The scenarios considered are (1) on a module base, (2) across a course spanning several years and (3) across schools showing the increased complexity from scenario 1 up to scenario 3. IN the following, we will discuss in detail the FLOSS-like inside approach. The FLOSS-like outside approach and the hybrid approach are discussed only with regard to those features that are characteristic for these approaches.

4.1 FLOSS-like inside approach

The FLOSS-like inside approach involves applying the principles identified in FLOSS-like communities and implementing them directly into Higher Education. In line with Fischer's work (2007), this approach involves mapping the key principles onto education, including an evolutionary growth of the course and its environment. This is to say that current students would build upon the work of earlier students developing course and content further year by year, therefore improving content quality and richness and providing regular feedback. Such feedback might refer to course structure, material, processes and tools.

As detailed by Fischer (2007), such an approach also aims at supporting self-directed learners within virtual learning communities by creating socio-technical environments that support new forms of collaborative design. It thus takes the sort of approaches and tools found in FLOSS as its inspiration. Fischer speaks of users creating socio-technical environments and has a continuum of participation ranging from passive consumer to meta-designer. These mirror some of the roles of engagement in FLOSS communities which range from passive users to core developers. Fischer is therefore taking the principles observed in FLOSS communities and mapping these onto higher education.

A general limitation of the inside approach is that the outside world remains disconnected. Though the institutional environments might be open for outside observers, analogue to e.g. MIT's Open Course Ware project[6], participation is limited to formally enrolled students, or we might see the same type of modules or courses with two isolated communication and collaboration environments. "Community building" and "evolutionary growth" within a given (HE) institution is per-se limited, due to e.g. 100% student turnover per semester / course and a comparatively small number of potential community member (formally enrolled students). However, as e.g. the case of "Students' Knowledge Base" at the Budapest University of Technology and Economics (BME)[7] illustrates, it is not an impossible attempt. The project started as an intranet site that was set up by 4-5 students living at the Schoenherz Dormitory of the Budapest University of Technology and Economics. During the first few months the site was only accessible within the dormitory. Only after this initial phase access to the site was opened up to the public. Meanwhile (by February 2008), there are 5980 pages of content, the wiki receives on average 1.2

[6] http://ocw.mit.edu
[7] See http://wiki.sch.bme.hu.

million hits per month, and there are more than 2600 registered users. This all happened without funding from the university.[8]

Table 4-1 illustrates some example scenarios of how the inside approach could be applied within HE. In this scenario, the complete course/module will be delivered using FLOSS-like approaches. All materials, communication, interaction and assignments will be transmitted using digital spaces.

The modular scenario requires the least degree of change of HE principles, but shows also the strongest restrictions with regard to the benefits that can be gained from FLOSS principles. The modular scenario appears thus as useful when, for instance, only a course is intended to incorporate FLOSS-like learning principles, or as a pilot before FLOSS-like principles shall be incorporated on a large scale but the organisation does not dispose of experience with these principles. The ease of monitoring the impact of FLOSS-like learning principles appears to be the most important advantage of this scenario.

The across years scenario is more complex than the modular scenario and reaches a larger scope of (potential) participants. However, the gain of participants that goes in line with the increased benefits of FLOSS-like learning principles (more participation, more interaction, advanced peer review, etc.) is achieved at the expense of decreased manageability and limited monitoring of learning processes and outcomes.

The across schools scenario appears to be the inside approach scenario that best taps the benefits of FLOSS-like learning principles, but it is aligned with even stronger limitations regarding manageability and monitoring than the across years scenario.

There are some challenges associated with the FLOSS-like inside approach which are depicted in Figure 4-1. These constraints relate to the organisation and administration of the transfer, and requirements from students and coordinators. While the former require especially financial means (budgets for technology, support, training), the latter are especially confronted with new skills requirements.

[8] See Glott, R. & Schmidt, P. (2008): Learning Opportunities in FLOSS. Presentation given at the FKFT Free Knowledge, Free Technology Conference on Education for a free information society, Barcelona, July 15th to 17th, 2008

FLOSS-like approach applied to a single module	FLOSS-like approach applied across years of a course	FLOSS-like approach applied across schools/departments
Implementation:		
Implementation simplified because coordinators only have 1 module to contend with at a time. Additionally, module coordinator has full control of delivery and content. However, this model is more difficult for the students participating as they will have to contend with several modules (communities) per session/semester.	Complex because got to think about the process and how it will operate across years.	Complex because got to consider the process of implementing across schools.
Size:		
Small group of members (i.e. per registration for module)	Large group of members because all years of a course are involved.	Potentially very large group members.
Activity degree:		
Active group because the community relates to their module with some observers that have an interest in the module topic	Active participation as the students will be required to participate in order to achieve course qualification.	Active participation as the students will be required to participate in order to achieve course qualification.
Monitoring:		
- peer: perhaps a $3^{rd}/4^{th}$ year student that has already undertaken the module can be responsible for monitoring the community - academic: e.g. a module lecturer could be responsible for overseeing the community	Monitoring will be complex due to the large numbers and the mixed experiences of members. Therefore, to ensure the community remains productive perhaps an academic staff member would have to be responsible for monitoring e.g. Module Coordinator.	Monitoring will be exceptionally complex and difficult. Require constant attention because requires a specific support manager.

All materials and resources are delivered using FLOSS-like sites/spaces. Communication will be undertaken as well f2f as virtual using the tools provided by the community space. Students outputs, e.g. Project works will be made online available.		
	Materials and content has to be varied to apply to the various abilities across years. This could be problematic, perhaps there are 'year' sections on the community space which contain relevant materials for that year.	This community would function across multiple disciplines which is in line with real FLOSS communities. This is further explained in the Assessment section.
Open to any observers inside of the institution that perhaps wish to sit at the periphery to spectate. E.g. perhaps students that will be taking this module in the future would like to get an idea of what to expect and 3rd/4th year students as mentors.	Open for participation to students within the course and open to any observers inside of the institution that perhaps wish to sit at the periphery to watch e.g. perhaps students from other disciplines.	Open for participation to students within the course and open to any observers inside of the institution that perhaps wish to sit at the periphery to watch e.g. perhaps students from other disciplines.
Cost:		
Technological: relatively low because technology should already be in place via VLE e.g. blackboard/moodle etc.		
Man power: relatively low because module coordinator will be responsible for their module and would normally be delivering it in a traditional fashion. Training could be necessary for the coordinator which would perhaps increase the cost slightly.	Man power: will be higher than the module approach because a particular member of academic staff will need to manage the space e.g. a course coordinator in order to ensure the content and activity is productive and applicable to all levels of the course.	Manpower: as a result of the complexity of this community there would need to be a specific support role created in order to ensure productivity and control of the community.
Assessment:		
MANDATORY because the full module is being delivered as per FLOSS-like principles. Therefore, students must produce a product together.		

There will be some constraints in terms of determining individual contributions and plagiarism must also be carefully considered.	There will be constraints in terms of assessing individual contributions as per the module approach.	The overall product would need to be a result of collaboration from across the schools.
Additionally, a new assessment would need to be created each year so that new cohorts had a new challenge and were not tempted to plagiarize previous solutions. As (preferred) alternative new cohorts of students might build on the work of earlier students, so that reflection on and improvements of earlier works would build the base for assessment.	The assessment would have to have depth and be applicable to all years in order to be a worthwhile assignment.	E.g. a product could be the development of a computer game and ultimately the course itself. Consider the computer case as an assignment, the following schools might be involved in the course: - computing (development) - music (development) - business (Marketing - social sciences (social aspects) - education (pedagogical aspects)
Peer assessment possible, could also include 3rd/4th grade students of the module		
Content & discourse		
Content will be disconnected from the discourse of earlier students and therefore a valuable learning source might be lost. An involvement of future and earlier students might allow to fix this problem.	Content & discourse will be connected.	Content & discourse will be connected, if applied across years.

Table 4-1 FLOSS-like Inside Approach Scenario

4.1.1 Constraints of FLOSS-like Inside Approach

There are some challenges associated with the FLOSS-like Inside approach which are depicted in Figure 4-1 below.

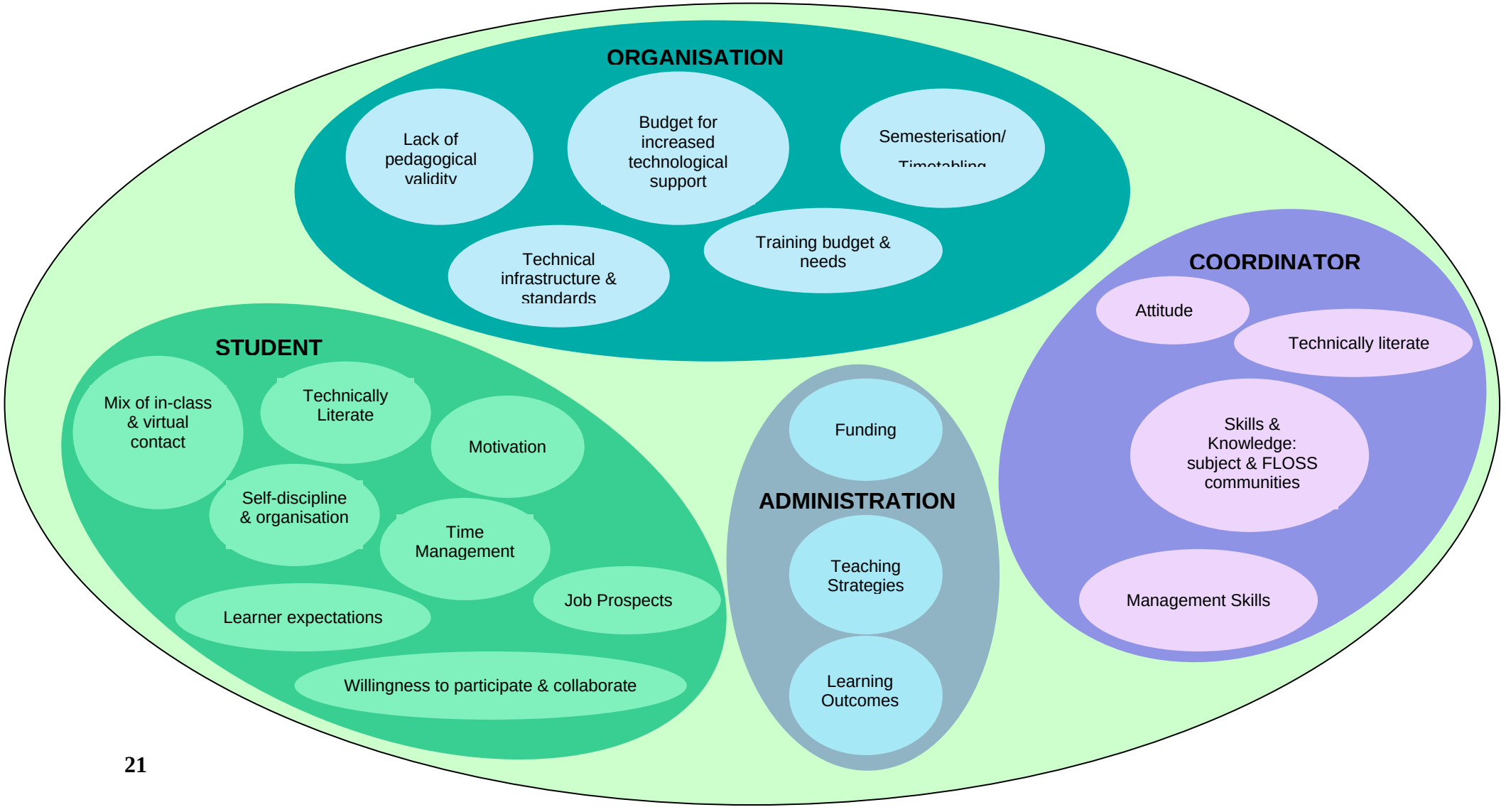

Figure 4-1 Challenges of FLOSS-like Inside Approach

4.2 FLOSS-like outside approach

In contrast to the inside approach, the outside approach takes traditional education as the starting point by providing theoretical information and then sends the students 'outside' to find FLOSS-like communities to work with and apply their theoretical knowledge.

This is seen in the work of the Aristotle University in Greece, where they send undergraduate students to real FLOSS communities as part of their degree in software engineering. They provide an initial academic background in principles of software engineering, testing software and the tools and approach in FLOSS communities and then require the students to choose and engage with a real project. This clearly has benefits in computer science as it gives students real experience of collaborating with other developers and also of the different types of role and work required in software development (see also: Teaching Software Engineering with FLOSS Projects).

The outside approach is not restricted to computer programming however. It can be realized whenever there is an external, 'real' community that is operating on FLOSS-like principles. Wikipedia is an obvious example, the case study University of Washington Bothell (US) also provides evidence that non-IT topics are suitable for such an approach. In the case of Washington Bothell students were required to contribute to actual Wikipedia articles as part of their assignment work, thus gaining much of the practical experience of collaboration and authenticity as experienced by the software programmers at Aristotle University.

Table 4-2 outlines potential scenarios of applying an Outside approach to HE. In these scenarios, students are equipped with the theory by attending traditional lecture style classes and tutorials and are then expected to apply their newfound knowledge within FLOSS-like communities as part of the course assessment.

The differences between the three scenarios are similar to the differences between the three scenarios of the FLOSS-like inside approach, i.e. the benefits from FLOSS principles grow gradually from the modular scenario over the across years scenario to the across schools scenario. However, these differences are less pronounced in the FLOSS-like outside approach than in the FLOSS-like inside approach, due to the fact that the former involves a (potentially worldwide) FLOSS-like community in all three scenarios, whereas the latter allows restricting the community to, for instance, course participants or enrolled students.

Strong similarities between the scenarios of the two different approaches can also be observed with regard to their constraints, as illustrated by Figure 4-2. This applies especially to the constraints in the fields of organisation and administration. Specifics of the FLOSS-like outside approach are that they require a strong motivation from the coordinator because he must be willing to coordinate processes and (at least indirectly) people that do not belong to the group of students that are the subject of the organisation's educational transfer project. This requires a continuous monitoring of the balance of what content (desired by the educational organisation) the students learn and how much time and effort the students and the educators use for leaning community-related matters that do not directly serve the organisation's educational goals. Related to this, there is a growing demand for management skills of the coordinator. On the side of the students, skills to decide which community to choose and to cope with the pressure of theory and practice are required.

FLOSS-like approach applied to a single module	FLOSS-like approach applied across years of a course	FLOSS-like approach applied across schools/departments
Implementation:		
Implementation simplified because coordinators only have 1 module to contend with at a time. Additionally, module coordinator has full control of delivery and content. However, this model is more difficult for the students participating as they will have to contend with several modules (communities) per session/semester.	Complex because got to think about the process and how it will operate across years.	Complex because got to consider the process of implementing across schools. This community would function across multiple disciplines which is in line with real FLOSS communities.
Size:		
Potentially very large group of total members, since students engage within established virtual communities. Small group of institutional student members (i.e. per registration for module).	Potentially very large group of total members, since students engage within established virtual communities. Large group of institutional student members because all years of a course are involved.	Potentially very large group of total members, since students engage within established virtual communities. Potentially very large group of institutional student members
Activity degree:		
Active group because the community relates to their module with some observers that have an interest in the module topic.	Active participation as the students will be required to participate in order to achieve course qualification.	Active participation as the students will be required to participate in order to achieve course qualification.
Monitoring:		

- peer: perhaps a 3rd/4th year student that has already undertaken the module can be responsible for monitoring the community - academic: e.g. a module lecturer could be responsible for overseeing the community	Monitoring will be complex due to the large numbers and the mixed experiences of members. Therefore, to ensure the community remains productive perhaps an academic staff member would have to be responsible for monitoring e.g. Module Coordinator.	Monitoring will be exceptionally complex and difficult. Require constant attention because requires a specific support manager.
Students might be taught the theory of the module subject in a traditional fashion. However, materials and communication may be provided by the institution in a structured way using the FLOSS-like space as an additional resource for the students.		
	Therefore, if materials were being provided via those spaces then they would have to be varied to apply to the various abilities across years. This could be problematic, perhaps there are 'year' sections on the community space which contain relevant materials for that year.	Therefore, if materials were being provided via those spaces then they would have to be varied to be applicable to the various disciplines across schools. This could be problematic, perhaps there are 'school' sections on the community space which contain relevant materials for that discipline. However, these spaces will be open to all.
Cost:		
Technological: relatively low or neutral. Established outside spaces are free of charge. However monetary contributions to support those communities might be considered from a sustainable and ethical perspective and modification of the VLE in place (e.g. blackboard/moodle etc) might be desirable to create bridges to the outside spaces by introducing open APIs.		
Man power: relatively low because module coordinator will be responsible for their module and would normally be delivering it in a traditional fashion. Training could be necessary for the coordinator which would perhaps increase the cost slightly.	Man power: will be higher than the module approach because a particular member of academic staff will need to manage the space and coordinate various materials e.g. a course coordinator in order to ensure the content and activity is productive and applicable to all levels of the course.	Manpower: as a result of the complexity of this community there would need to be a specific support role created in order to ensure productivity and control of the community.

Assessment:		
MANDATORY because this will be the element of the module where students are expected to undertake work with a FLOSS-like community.	As with the Module approach the assessment will need to be MANDATORY because this will be the element of the module where students are expected to undertake work with a FLOSS-like community.	MANDATORY because it is this element of the course that relates to participation in a FLOSS-like community. Therefore, students must produce a product together.
The module coordinator has the option to offer a selection of recognized FLOSS-like communities for students to work with or as part of the assessment students could be expected to identify a community for themselves.	The course and module coordinators have the option to offer a selection of recognized FLOSS-like communities for students to work with or as part of the assessment students could be expected to identify a community for themselves.	
There will be some constraints in terms of determining individual contributions and plagiarism must also be carefully considered.		
Peer assessment possible, could also include 3rd/4th grade students of the module.		
Content & discourse		
Content and discourse are connected, though it might appear disconnected for students once being new within an established outside community. Possibility that much of earlier learning processes and outputs will be lost.	Content and discourse are connected, and if applied across years earlier students might facilitate the entrance of new students allowing them to faster relate content and discourse.	

Table 4-2 FLOSS-like Outside Approach Scenario

4.2.1 Challenges of the Outside Approach

Likewise there are some challenges that need to be considered when considering implementing the FLOSS-like Outside approach as exemplified in Figure 4-2.

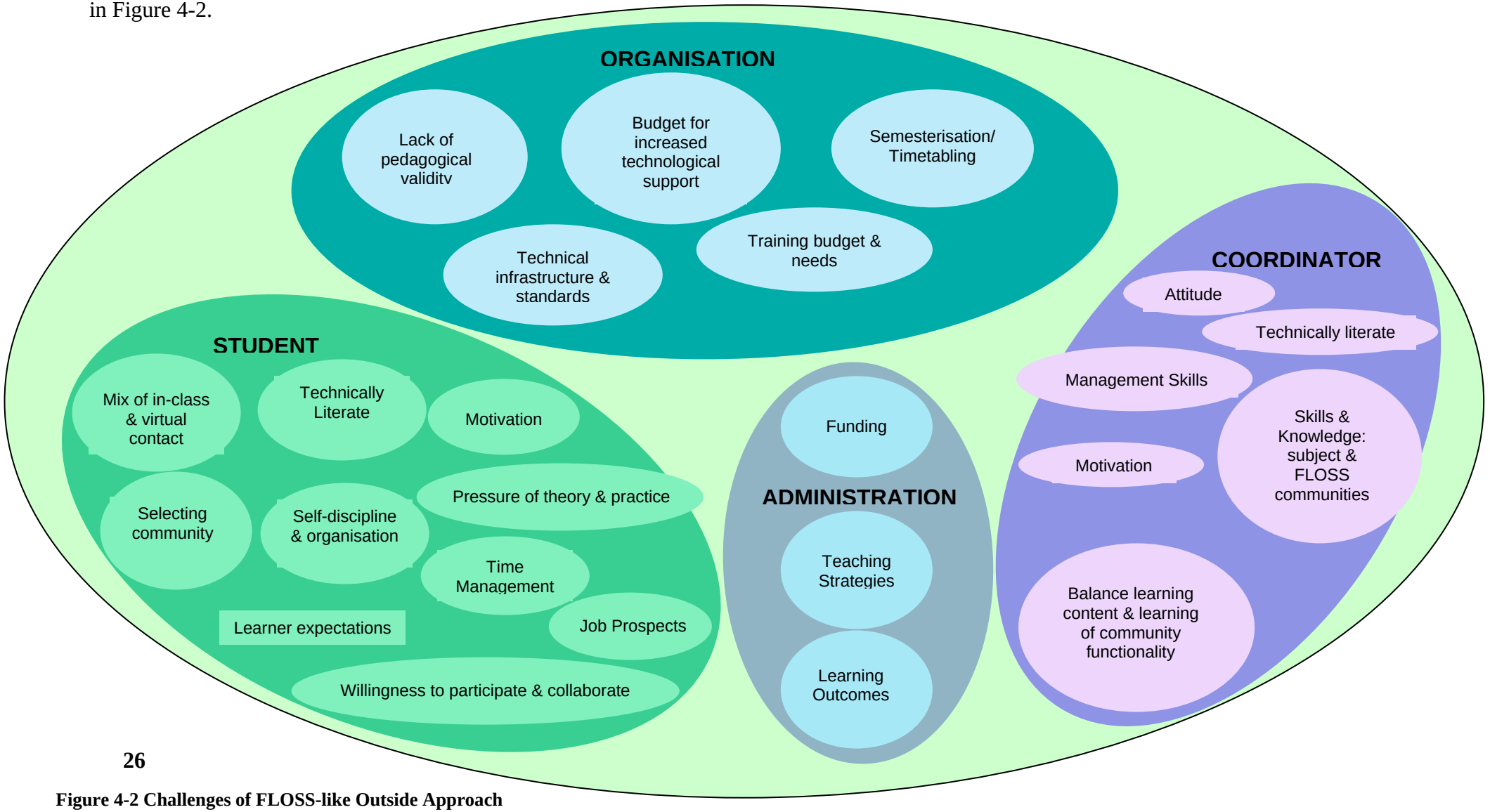

Figure 4-2 Challenges of FLOSS-like Outside Approach

4.3 Hybrid approach

If we view FLOSS inside and FLOSS outside approaches as opposite ends of a spectrum, then there is clearly a range of blended, hybrid approaches in between, which incorporate components of both elements and, in the best case, combine their relative advantages in the optimal way. At this early stage of the adoption of FLOSS-like learning principles in HE there are few examples that recombine both, an inside and an outside approach.

Perhaps one such model for this hybrid approach is that of an open participatory learning ecosystem, as outlined by John Seely Brown (2007). The concept here is that some of the principles of FLOSS communities are adopted in education (thus it is an inside approach), such as collaboration, use of technologies, peer production. People learn by doing, for example by recombining content that is viewed by others. However, these activities occur in a broader ecosystem that is open for everyone, including students, informal learners, tutors, experts, organizations, etc, and in this manner it is FLOSS-outside approach since learners are engaged in a real community. This approach is effectively blurring the boundaries of traditional HE institutions like the university and would give the name “Open University” a very different meaning.

In this scenario, the students have the best of both worlds as they are free to move between a traditional environment and FLOSS-like communities to gain knowledge, insight and guidance.

Table 4-3 below outlines the hybrid approach. Like in the other two approaches, the benefits from FLOSS-like learning principles as well as the complexity and difficulties to manage the transfer project increase gradually from the modular scenario over the across years scenario to the across schools scenario. The main difference is that both, problems and benefits, of the previously discussed scenarios of the other two approaches appear combined. This results in the same constraints as in the FLOSS-like outside approach, except for the fact that the hybrid approach requires from coordinators as well as from students the capacities to monitor and handle the blurred learning outcomes (see Figure 4-3).

FLOSS-like approach applied to a single module	FLOSS-like approach applied across years of a course	FLOSS-like approach applied across schools/departments
Implementation:		
Implementation simplified because coordinators only have 1 module to contend with at a time. Additionally, module coordinator has full control of delivery and content. However, this model is more difficult for the students participating as they will have to contend with several modules (communities) per session/semester.	Complex because got to think about the process and how it will operate across years.	Complex because got to consider the process of implementing across schools.
Size:		
Potentially very large group of total members, since students engage within the virtual world. Small group of institutional student members (i.e. per registration for module).	Potentially very large group of total members, since students engage within the virtual world. Large group of institutional student members because all years of a course are involved.	Potentially very large group of total members, since students engage within the virtual world. Potentially very large group of institutional student members.
Activity degree:		
Active group because the community relates to their module with some observers that have an interest in the module topic.	Active participation as the students will be required to participate in order to achieve course qualification.	
Monitoring:		

- peer: perhaps a 3rd/4th year student that has already undertaken the module can be responsible for monitoring the community - academic: e.g. a module lecturer could be responsible for overseeing the community	Monitoring will be complex due to the large numbers and the mixed experiences of members. Therefore, to ensure the community remains productive perhaps an academic staff member would have to be responsible for monitoring e.g. Module Coordinator.	Monitoring will be exceptionally complex and difficult. Require constant attention because requires a specific support manager. This community would function across multiple disciplines which is in line with real FLOSS communities.
All materials and resources are delivered using FLOSS-like sites/spaces, institutional ones as well as established web based spaces. Communication will be undertaken as well F2F as virtual using the tools provided by the vast range of associated community spaces.		
Students might be taught the theory of the module subject in a traditional more structured way, in the case required.		
Students benefit from being able flip between traditional settings and the FLOSS-like ones as they see fits best.	Materials being provided via the space are varied to apply to the various abilities across years. This could be problematic, perhaps there are 'year' sections on the community space which contain relevant materials for that year. Again students benefit from being able to move between traditional environment and FLOSS-like environment for materials, support and guidance.	Materials being provided via the space are varied to be applicable to the various disciplines across schools. This could be problematic, perhaps there are 'school' sections on the community space which contain relevant materials for that discipline. However, these spaces will be open to all. Students also benefit from the option to move between FLOSS-like and traditional education.
Cost:		
Likely involves investment to create open APIs to the institutional VLE that allow tracking, structuring, evaluating and rating the various artifacts involved. Those investments might be moderate, but also could require the abandance and replacement of current solutions.		

Man power: relatively low because module coordinator will be responsible for their module and would normally be delivering it in a traditional fashion. Training could be necessary for the coordinator which would perhaps increase the cost slightly.	Man power: will be higher than the module approach because a particular member of academic staff will need to manage the space and coordinate various materials e.g. a course coordinator in order to ensure the content and activity is productive and applicable to all levels of the course.	Manpower: as a result of the complexity of this community there would need to be a specific support role created in order to ensure productivity and control of the community.
Assessment:		
MANDATORY - There will be the need of some type of assessment, which might consist of a mix and that might need to be more tailored, which comes as a challenge for mass education.		
There will be some constraints in terms of determining individual contributions and plagiarism must also be carefully considered.	The assignment would need to be carefully considered to ensure that it has depth and applicability to all students across the years.	The overall product would need to be a result of collaboration from across the schools.
		E.g. if the chosen assignment was formal then the students could be asked to produce a computer game and as outlined in the Inside Approach a variety of disciplines can be involved in the production.
Content & discourse		
Content and discourse are connected on 2 level: 1. the human level consisting of information broker and 2. through technology.		

Table 4-3 FLOSS-like Hybrid (Inside-Outside) Approach Scenario

4.3.1 Challenges of the Hybrid Approach

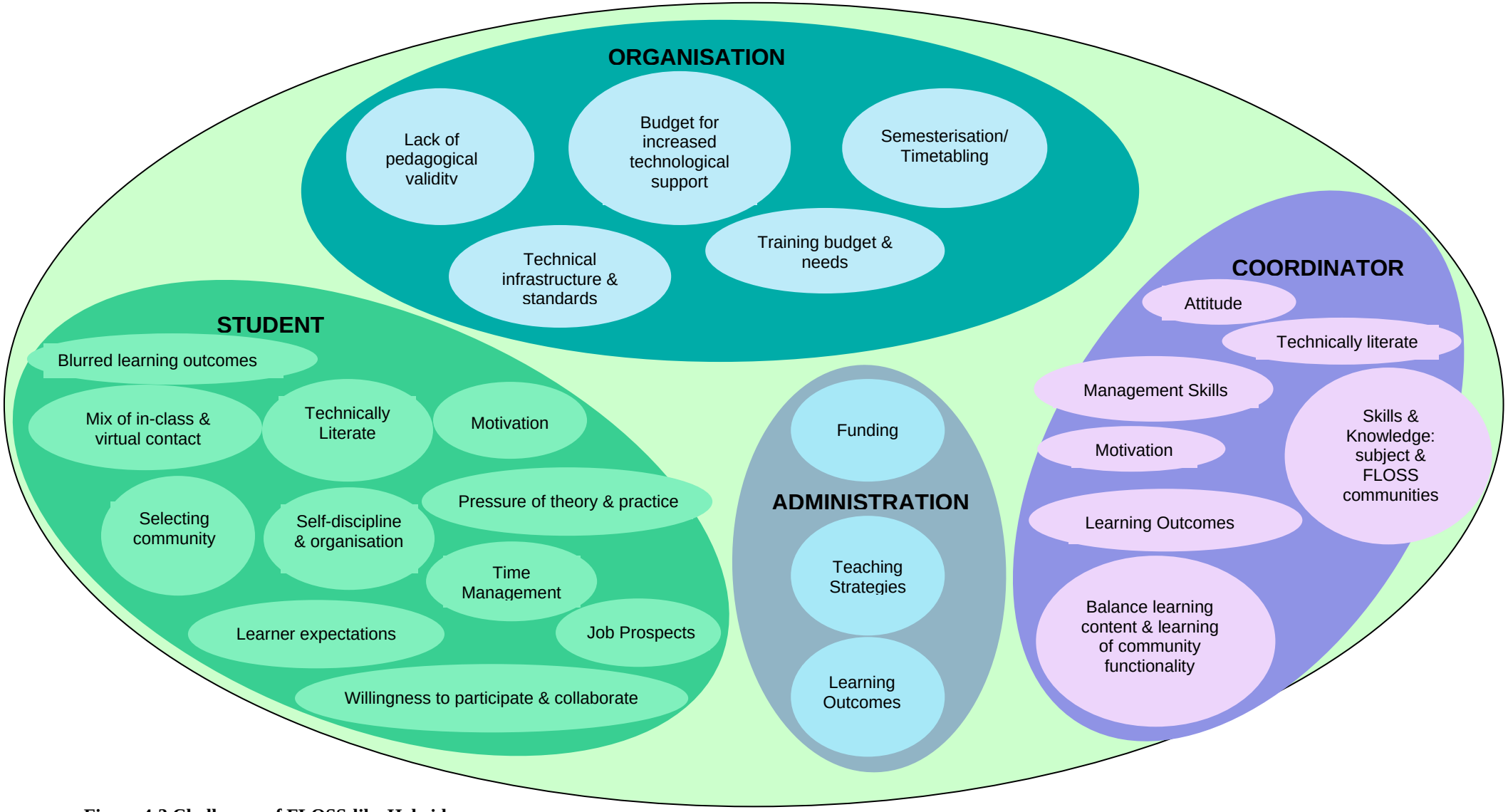

Figure 4-3 Challenges of FLOSS-like Hybrid Approach

5 Guidelines for Higher Education

The discussion of FLOSS-like learning principles, scenarios and constraints allows drawing specific conclusions for implementation strategies of FLOSS-like learning principles in HE.

These are provided below in form of guidelines. More general conclusions are provided in chapter 6.

Design of the transfer project

- check if there is demand and support for an adoption of FLOSS-like learning principles in your organization
- check if there is a FLOSS-like community suitable to the educational field in which you would like to implement FLOSS-like learning principles
- determine the scope of the transfer (e.g. student research project, single course, complete degree program, etc.)
- determine the degree of control you want to exercise (and how much self-control you allow the students / the community)
- determine the time frame
- determine the technology you need
- determine the manpower and the skills you need in your organization to initiate and supervise the project
- determine the budget you need
- check if there is any support from the FLOSS-like community you plan to select for your project and get in touch with contact persons, provide them with information, and ask for recommendations
- determine incentives for students (degrees, proofs of informally attained skills)
- determine the outcomes to be evaluated (what shall be learnt?), and the evaluators

Initiate the project

- provide the basic content on which the self-organised learning experience of the students shall build upon
- provide the basic technology for the project
- determine coordinators
- define tasks for students
- explain expectations and incentives to the students
- give students freedom to participate in different ways and communities (if outside approach or hybrid approach)

Run and monitor the process

- determine assessment criteria: what indicators are used in order to measure students performance
- determine assessment procedures: where is open assessment through students/community applied and where formal assessment through educators at the educational organisation
- organise peer-reviewing as an integral element of the students' exercise
- decide what to review by peers, for instance:
- processes and outcomes of individual learning
- content
- system level (operational organization, organizational structure)
- technology
- interactions and communications
- formal reviews by educators (i.e. get community feedback on your formal assessment)
- organise formal reviewing by educators

Evaluation

- check if educational objectives have been achieved
- check if technology has been working properly
- check if input (money, manpower) is justified when outcomes of the project are regarded
- check peer reviews of project in order to evaluate possible improvements / changes
- check if a community has been established that maintains the project (if outside or hybrid approach)
- define changes for next round

6 Conclusion

This report started from previous findings of the FLOSSCOM project, confirming that adopting FLOSS-like learning principles in HE bears a great potential for the improvement of education. There are many advantages for the learner in FLOSS communities. These include access to a variety of resources, learning by doing, community support, mentorship and engagement. The main argument with regard to the transfer of FLOSS-like learning principles is that the goal of such a transfer should not be a full replacement of one system (traditional HE) through another (FLOSS-like learning), but the optimal recombination of the relative advantages of both systems in order to achieve maximal synergies.

In this sense, different approaches to the transfer of FLOSS-like learning principles have been compared and discussed: FLOSS-like inside, FLOSS-like outside, and a hybrid approach. The case studies that were carried out in previous stages of the FLOSSCOM project and to which this report repeatedly refers illustrate that the adoption of FLOSS principles in HE has largely been successful.

The final outcome of this report is a set of guidelines that shall help decision-makers to develop and realise projects to transfer FLOSS-like learning principles in traditional educational settings in a controllable way.

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